7.—Late Quaternary Eustatic Changes in the Swan River District

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Pollen analyses have been made on a submerged fresh water peat from 68 feet below sea level. The radiocarbon age of this peat is 9,850 ± 130 years before 1958. The implications of change in sea level are discussed. Late Quaternary shore lines to the west of Fremantle have been mapped and show that Rottnest and Garden Islands have been isolated from the mainland since about 5,000 B.C.

Introduction

In 1957, through the courtesy of Mr. G. F. U. Baker, the Main Roads Department kindly offered the author a number of samples from bores drilled for the construction of a bridge over the Swan River at "The Narrows," between Mount Eliza and Mill Point near Perth.

One of these samples was an old submerged peat from Bore No. 7, at a depth of 68 feet below mean sea level. A pollen analysis was made of this sample in the University Department of Botany, and the peat was then dried and sent to the New Zealand Department of Scientific and Industrial Research, Division of Nuclear Sciences, for radiocarbon dating. The age given for this sample (No. CR.721) was 9,850 ± 130 years before 1958 (B.P.)

Pollen Analysis

The sample of peat was black, hard and brittle when dry, breaking with a conchoidal fracture. It dissolved readily in boiling alkali (10% KOH) and the residue was then treated with acetic anhydride and concentrated sulphuric acid in the proportions 9 : 1.

The following pollen types were identified in preparations from the residues:

Eucalyptus wandoo
E. gomphocephala
Casuarina
Acacia
Myriophyllum
Pteridium
Cyperaceadites
Proteacidites
Hystrichosphaerideae
Fungal hyphae

Preservation of the grains was very good, the only indication of alteration being the loss of the exospore from *Pteridium* spores. This also occurs in preparations of spores from living material and is serious, as it prevents the distinction being made between fossil spores of *Pteridium* and those of *Cyathea*. As the present Australian species of *Cyathea* are confined to the Eastern States, it is probable although by no means proved, that the spores in this peat are those of *Pteridium* (Bracken fern).

Eucalyptus pollen was the most abundant and showed a similarity both in size and morphology to living Wandoo (*Eucalyptus wandoo* Blakely), and Tuart (*E. gomphocephala A.D.C.*). The Hystrichosphaerideae are represented by two forms, both of which are found in brackish to fresh water swamps along the coast between Walpole and Flinders Bay. The presence of the swamp plant *Myriophyllum* confirms the brackish to fresh water conditions of the peat, and the preservation of fungal hyphae suggests deposition under aerobic conditions. The present distribution of the Tuart shows edaphic restriction to the Coastal Limestone, but Wandoo, where it occurs on the Swan Coastal Plain, is confined to clay. Both species are still found along the Swan River but nowhere do their present distributions overlap.

It is now thought that 9,850 ± 130 years B.P. or at approximately 7,900 years B.C., when the Swan River was more than 68 feet below its present level, swampy clay flats were exposed along the river banks in the vicinity of Mill Point and Mount Eliza. The clay soils of this area supported Wandoo, while nearby calcareous soils supported Tuart.

Significance of Sea Level Changes

The low stand of water level at the Narrows 9,850 years ago supports the observations of Baker (1956), that Melville Water and Freshwater Bay cover an ancient drowned river channel at 60-75 feet and 120-140 feet below datum.

More important however, is the fact that when sea level was 68 feet or more below its present level, Rottnest, Carnac and Garden Islands would have been high ridges on a coastal plain extending out from the mainland, to what is now the 11 fathom line.

Godwin, Suggate and Willis (1958) have collected data on radiocarbon dated samples, thought to represent local low stands of sea level, from such widespread localities as the Gulf of Mexico, New Zealand, Victoria, the South Baltic, British coast and the Persian Gulf. By collating this data, local isostatic effects have been masked by the general trends, thereby enabling a more accurate record of the history of eustatic rise in sea level to be made. The data of these workers have been plotted in Fig. I, together with the dating from the Narrows Bore, No. 7. This date agrees so well

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with the trends of Godwin and his co-workers that it seems safe to assume that in the Swan River District, over the past 14,000 years, eustatic changes have been more active than isostatic change.

It is apparent that sea level has steadily risen from forty fathoms in 12,000 B.C. to the same level as now, in 3,000 B.C. How high the sea rose before returning to its present level is still unknown. However, fossil coral reefs from Dirk Hartog Island (B. Logan, pers. comm.), Abrolhos Island (Teichert 1947), and Rottnest Island (Teichert 1950) are found with their upper surfaces standing at 5, 11 and 6 feet respectively above mean sea level. If these coral reefs are younger than 3,000 B.C., sea level over the last 5,000 years has been at least 10 feet higher than now and has subsequently lowered to its present level.

If the present bathymetry of the continental shelf to the west of Fremantle can be taken as an indication of old shorelines as sea level rose throughout the Recent, then the position of these strandlines may be mapped. Fig. 2, A, B, C, and D have been prepared from data on Admiralty Chart No. 1058 published in 1955, with small corrections to 1957.

From Fig. 2 the following events can be summarized:—

1. Rising sea level since 12,000 B.C. has flooded and drowned an old dune topography situated between Perth and Rottnest.
2. Cockburn Sound was an interdunal lake before rising seas flooded it. This flooding is thought to have taken place between 3,000 and 4,000 B.C.
3. The Swan River crossed the exposed coastal plain in 6,000 B.C. and discharged into a wide bay about 5 miles E.N.E. of Rottnest.
4. If the present five fathom contour line is taken as forming the last continuous land bridge from Rottnest to Garden Island and the mainland, then Rottnest has been cut off from this peninsula, as an island, since approximately 5,000 B.C. Garden Island was probably cut off from the mainland at the same time, although numerous small islands would have existed between Cape Peron and the southern end of Garden Island.

References

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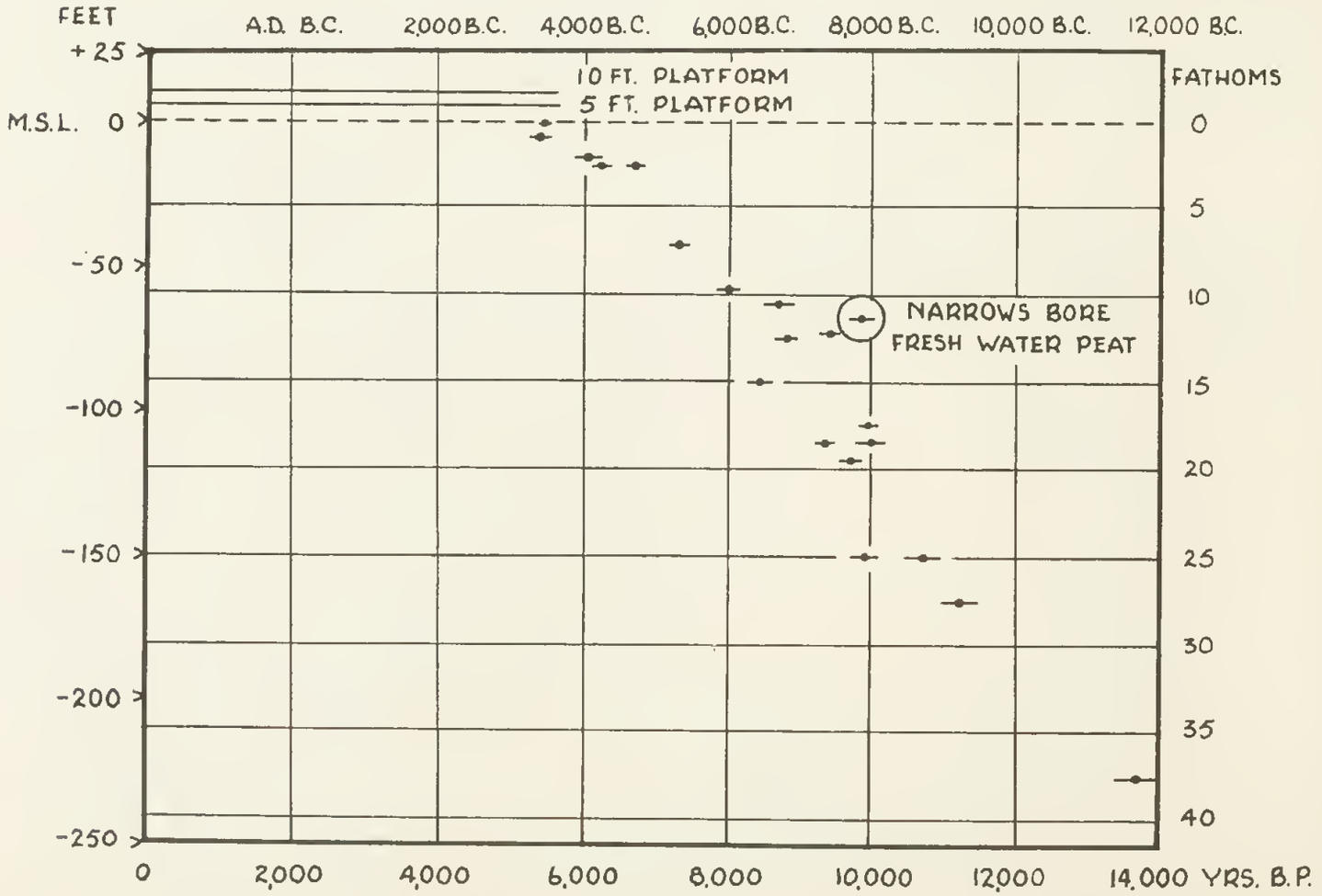

Fig. 1.—Eustatic changes of the sea to the present level, as indicated by samples deposited close to their contemporary levels. Data mainly from Godwin *et al.* but including samples from "The Narrows."

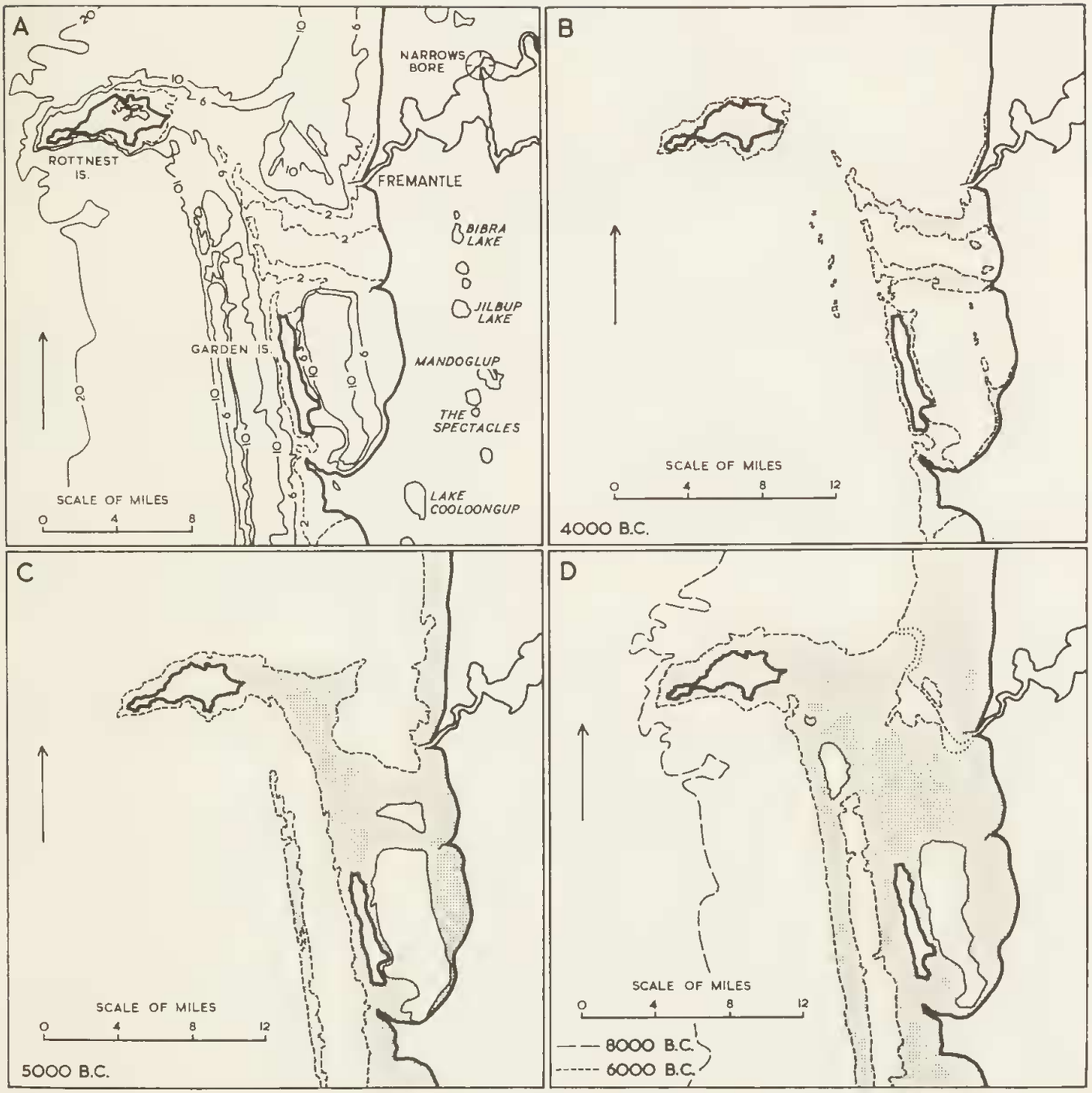

Fig 2.—(A) Present bathymetry Fremantle-Rottnest Island area. (B, C, D) Location of shorelines at 4,000, 5,000, 6,000 and 8,000 B.C., as deduced from rate of sea level change and present bathymetry. Stippled area shows extent of exposed coastal plain, beyond its present configuration.